

Using Field-to-Lab Testing to Connect Design, Manufacture and Deployment of SDR and CR

Erik Org
Sr. Marketing Manager
Azimuth Systems

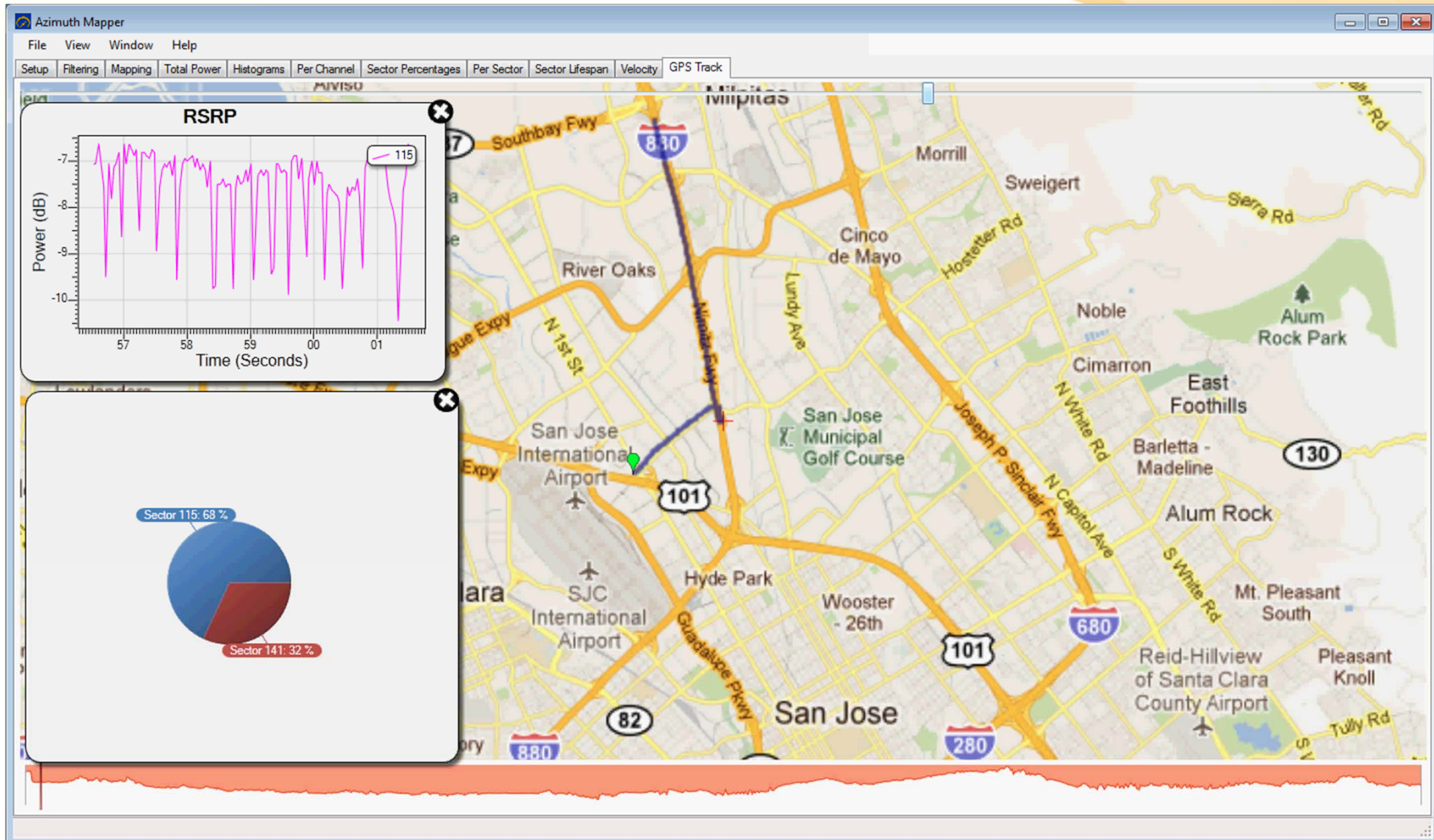
Topics

- Introduction
- Solution Overview
- Architecture
- A Complete End-to-End Solution
- Productivity and Costs Savings with Field-to-Lab
- Summary

Recreating dynamic real world transients is challenging

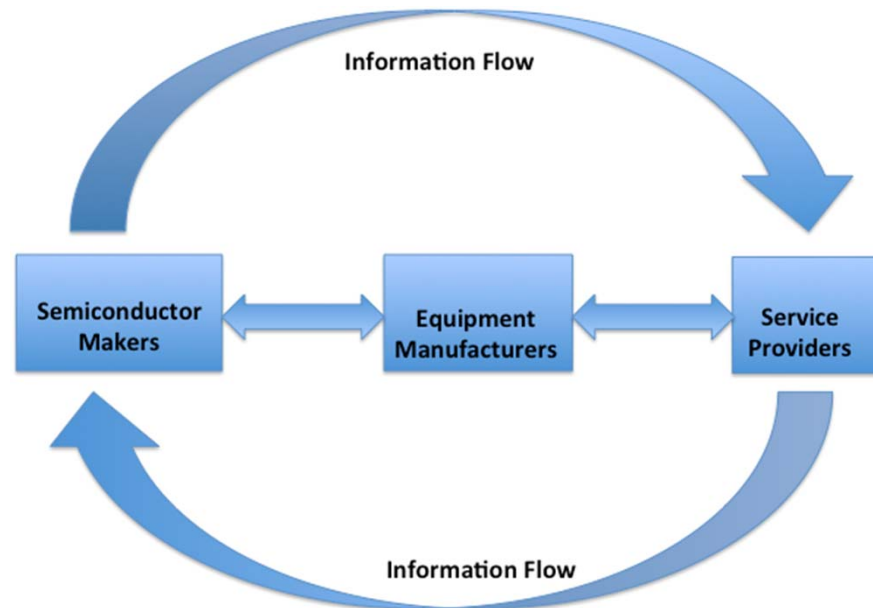


Field-to-Lab solutions can solve that problem



Wanted: a common test environment

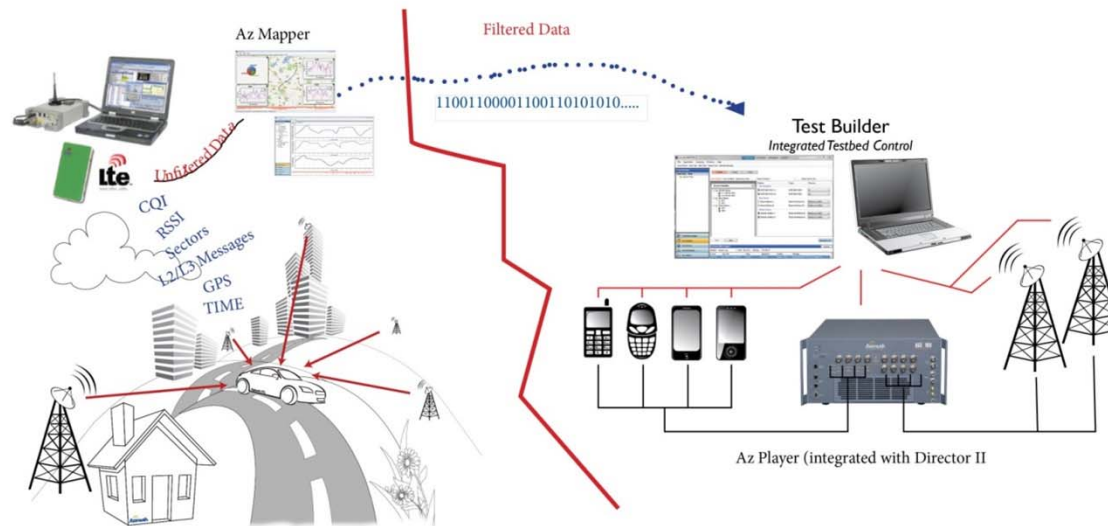
- R&D, Device OEMs and Network Operators can be challenged to troubleshoot *real world* problems
 - It's not easy to define a common test environment – what were the radio and network conditions at the time of the fault?
 - Need to perform end to end testing of the device
 - Need to perform interoperability
- For cognitive radio, the test plan must include some way to verify the real world decision making capability by measuring performance as the radio selects between frequencies, bandwidths, protocols and modulations in the face of dynamic impairments



The Solution

Field to Lab - A real world test solution which can capture dynamic real world radio environments as a playback file which can then be shared between ecosystem participants

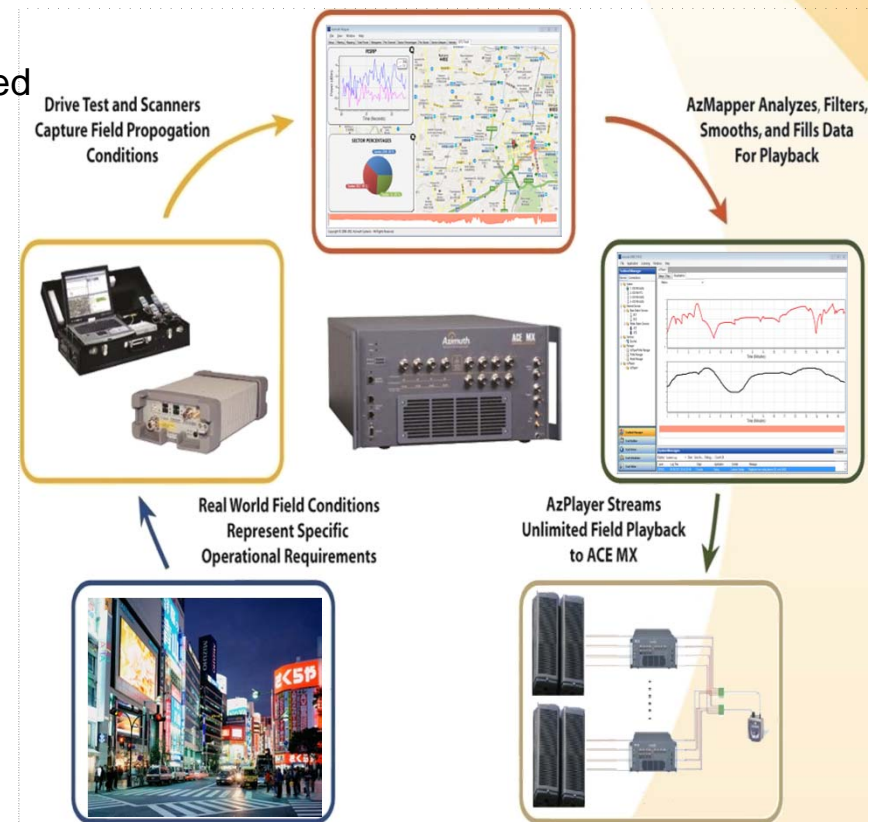
- Allows for visualization of the radio environment prior to lab playback
- Ensures an apples to apples comparison through use of a common test environment
- Accelerate troubleshoot and debug time through unlimited lab playback



Field-to-Lab Solution Overview

FTL Overview

- Completely automated, end-to-end, integrated solution
 - Map “real world” drive test and playback in lab
 - Repeatable qualification/validation with real-world data
 - Recreate and troubleshoot field problems in lab
 - Reduce product cost and time-to-market
- AzMapper software tools processes field logs
 - Selects from Unfiltered Data according to pre-defined algorithms
 - Builds playback files appropriate for the test bed
- ACE MX channel emulator with Real Time Playback (AzPlayer)
 - Fully-dynamic, complex modeling
 - Fast streaming of state conditions; unlimited duration
 - Dynamic correlation for MIMO scenarios
 - Data files from multiple sources
- Test Builder automation interface
 - Standardized, automated test capabilities
 - “Drag and Drop”
 - Control UE automation via TEMS
 - Full control of standard traffic generators: iperf, IxChariot, FTP transfers, Ping etc.



Unfiltered Data

- The original **Unfiltered Data** is **THE KEY** to isolating and correcting performance issues.
- Filtered data (suitable for replay in the lab because the **dataset has been reduced to an order that is manageable by the testbed**) is replayed and is useful only if the original selection algorithm (whether human expert or algorithmic) was effective in identifying the most likely sources of any problems under analysis.
- Typical Scanner Logs consist of the following types of unfiltered data:
 - RSSI
 - RSRP
 - RSRQ
 - SINR/Ec/Io
 - CQI
 - RI
 - PMI
 - Throughput information
 - BLER information
 - Call drop information/call statistics
 - Sector information
 - Time Stamp
 - GPS Coordinates
 - L2/L3 Messaging

AzMapper

- Extracts information from the scanned data to be customized for playback in a lab testbed. AzMapper is cognizant of the setup being used and maps the data to ensure accurate generation of the radio environment with the best possible use of resources.
 - Interprets the scanner-specific proprietary data and loads it so that scanner data from any scanner can be used.
 - Removes artificial effects induced by the scanner or measurement technique to facilitate the recreation of real world conditions without any spurious vestiges.
- Allows you to test different scenarios by providing a flexible and powerful mechanism to control all the critical parameters.
- Generates rich, useful, and intuitive plots of the data at different points in the system, allowing you to visualize the data and the effect of the parameter values.
- Provides a flexible and modular platform to run custom algorithms and scripts.
- AzMapper also allows you to filter the data based on some criteria (such as 10 min segments around call drops for instance). So, if your operator gave you a log with a 1 min window, but you wanted a 10min window that would be difficult to do. Also, having AzMapper would allow you to specify some other criteria such as segments right after a particular DL message was sent
- **AzMapper is dependent upon the mapping selected by the expert user and embedded algorithms to produce useful reports and files for playback**

AzPlayer (Azimuth Player)

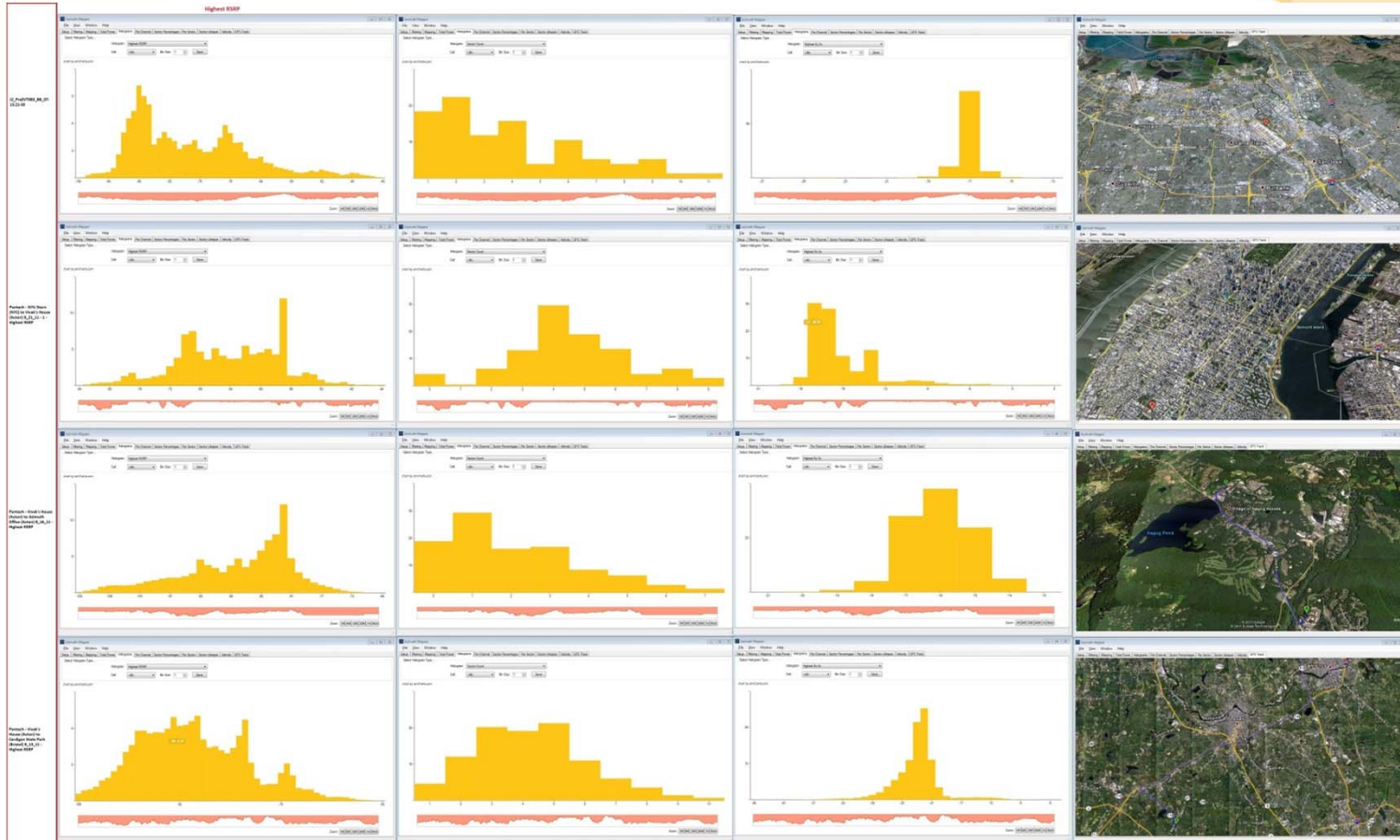
- AzPlayer streams data real time channel information to the ACE MXs to create realistic, complex, dynamic models
- Uses the custom built Real-Time Playback engine that offers infinite flexibility and ensures ease of use
- All major channel parameters can be controlled
 - PDP, velocity, SNR/AWGN, output power, etc.
- Synchronization across multiple physical ACE MX units supported
- Provides input power tracking and output path loss calibration

Visualizing KPIs in AzPlayer

The screenshot displays the Azimuth DIRECTOR II interface. On the left is the Testbed Manager tree view, showing a hierarchy of System, External Devices (Base Station Devices and Mobile Station Devices), Services, Manager, and AzPlayers. The main area shows the AzPlayer1 configuration and visualization. The 'Visualizations' tab is active, displaying two line graphs: 'Output power' (red line) and 'Throughput' (black line), both plotted against 'Time (Minutes)' from 0 to 16. The 'Output power' graph shows a red line fluctuating between approximately 0.5 and 1.5. The 'Throughput' graph shows a black line fluctuating between approximately 0.5 and 1.5. Below the graphs is a System Messages panel with a table of log entries.

Level	Log Time	Origin	Application	Context	Message
DEBUG	09/06/2011 02:42:25 AM	Console	Syslog	Listener Update	Registered new syslog listener (ID: sock2448)

Azimuth Field-to-Lab Profiles



Profile channel conditions across multiple routes

End-to-End, Automated Performance and Handover Testing

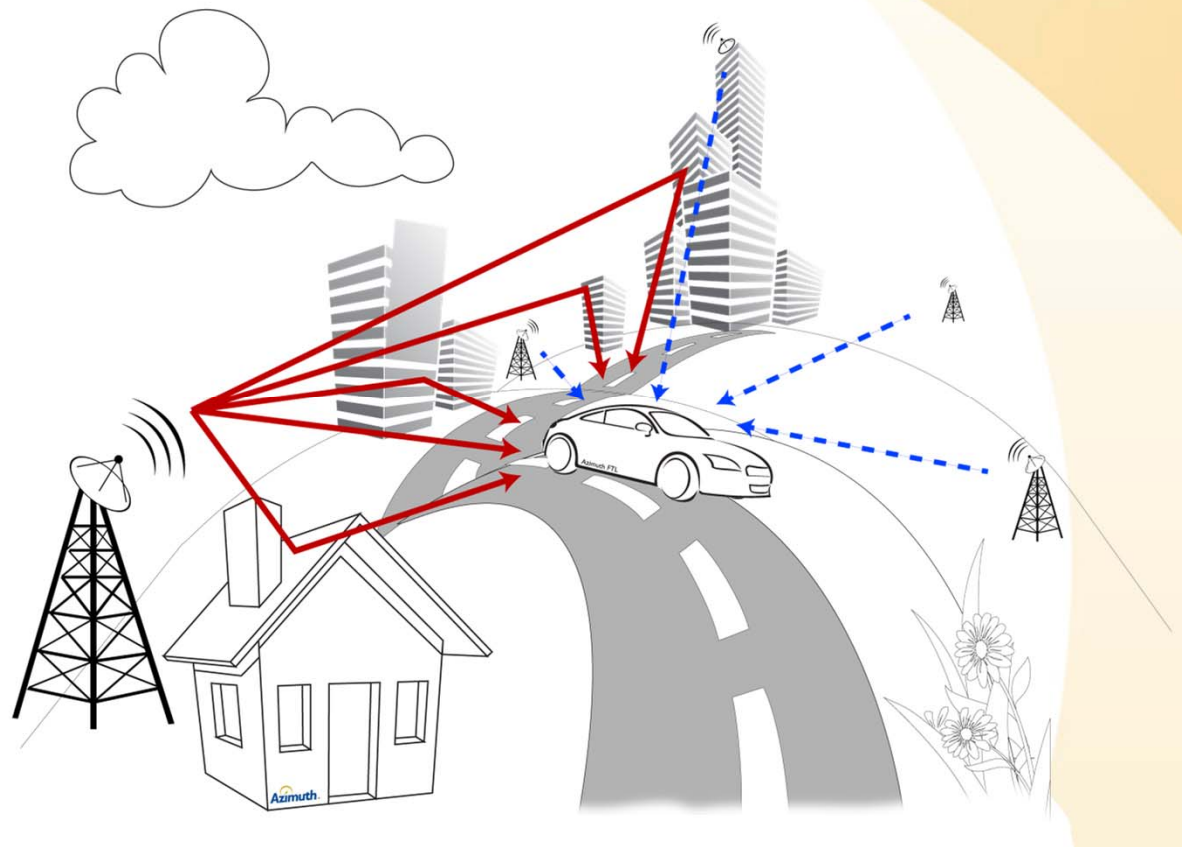
An Automated End-to-End Solution

- Integrated Testbed Manager that automates
 - ACE MX
 - Third part equipment
 - Multiple base stations, base station emulators
- Complete automation of TEMS
 - Provides control of third party UE
- Support for automation for mobile devices
- Creation of fully automated test cases
 - Traffic generation and analysis
 - Comparative Benchmarking
 - Device Automation
 - Test Synchronization

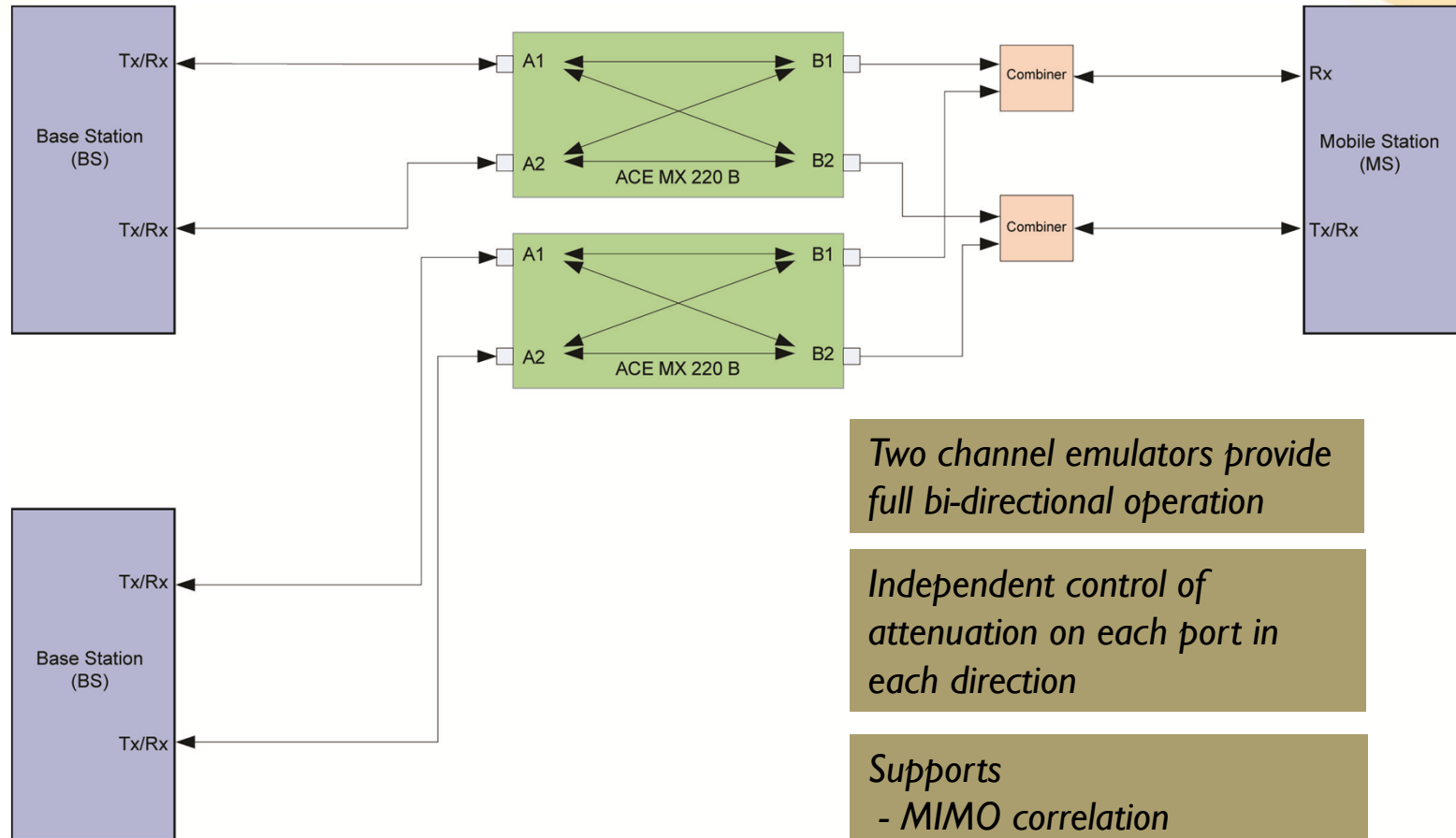


Full Dynamic Control of Primary Links AND Interferers

- 8x4 Bidirectional Test Bed enables playback of Multiple 2x2 Primary Communication Channel
- Leverage additional capability of 8x4 Test Bed to model additional interferers
- Fade and dynamically control primary and secondary communication channels as well as interferers



Fully Bi-Directional Inter-Rat Handover Test Configuration Using Field to Lab



Two channel emulators provide full bi-directional operation

Independent control of attenuation on each port in each direction

Supports

- MIMO correlation
- TDD or FDD
- Unlimited multi-segment handover testing

Field-to-Lab offers detailed control of channel parameters

- AzPlayer streams data real time channel information to the ACE MXs to create realistic, complex, dynamic models
- Uses the custom built Real-Time Playback engine that offers infinite flexibility and ensures ease of use (unlimited playback file size)
- All major channel parameters can be controlled
 - PDP, velocity, SNR/AWGN, output power, etc.
- Custom channel Figure of Merit (RSRP and RSRQ) can be implemented to exercise specific use cases
- Provides input power tracking and output path loss calibration

SUMMARY

Field-to-Lab Solution Summary

Azimuth Field-to-Lab is a completely automated, end-to-end, integrated solution that brings the real-world into the lab to

- Test how dynamic radio environments affect cognitive radio decision making and the resulting radio performance.
- Provide a common test environment across the ecosystem
- Predict the performance of a device across your network before going to the field
- Test and verify changes to infrastructure or device software before rolling it out to the field
- Reduce the amount of time, money and effort to recreate and debug issues and verify the fixes

Thank You

Erik Org

Sr. Marketing Manager

Azimuth Systems

erik_org@azimuthsystems.com

+1.617.407.2968